Collecting *Vitis berlandieri* from Native Habitat Sites

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Abstract

Lime content is the major difference between Northern American and European vine growing soils. This resulted in significant difficulties in the development of rootstocks for European conditions at the end of the 19th and the beginning of the 20th century. It was only the introduction of *Vitis berlandieri* as a breeding partner that led to lime-tolerant rootstocks. Despite the importance of *V. berlandieri* for European viticulture, only a few accessions have so far been exploited for breeding rootstocks. In most cases, these vines were only used because they were available in Europe at that time. The genetic variability of the species is certainly much larger. To preserve and evaluate genetic diversity in *V. berlandieri*, grape berries from 86 individual vines were collected in September 2005 from a large range of natural stands in Texas, United States. The collection locations were found in 13 counties and across a distribution from N 31° 23' to N 29° 43' and W 100° 2' to W 97° 26'. Vines will be planted in germplasm collections and evaluated for their rooting and grafting ability, their lime tolerance, and other viticultural features. Superior types will then be utilized for rootstock breeding programs.

INTRODUCTION

Rootstock breeding was initiated at the end of the 19th century in Europe as a response to the phylloxera epidemic. At that time, only a small number of individuals of some wild species resistant to the pest were available for breeding. Exotic species were rare in Europe and the breeders could not be too choosy in making their choice of parents. These were mostly selections from the North American wild species *Vitis riparia*, *Vitis rupestris*, and *Vitis berlandieri*. The results of hybridization among these species and selections were rootstock varieties that had varying amounts of phylloxera resistance or tolerance, rooting ability, affinity to scion varieties, and adaptation to different soil types.

All rootstocks in use today in principal derive from these very few individuals of the wild species of North America, with only a small part of the natural genetic resources being utilized in rootstock breeding so far. In order to find new donors of desired traits such as adaptation of rootstocks to soils, we should examine the genetic diversity among the primary rootstock species.

The European wine producing countries have many soil types with high lime content. The lack of adaptation of the rootstocks to these lime soils was a serious problem. The crosses of *V. riparia* and *V. rupestris* were not well adapted to the lime soils and chlorosis was the result in the scions. To improve the adaptation of the rootstock to lime soils, *V. berlandieri* was introduced as a breeding partner in rootstock improvement. Later on, *V. vinifera* was also examined as a lime tolerant partner in breeding for rootstocks even though the use of *V. vinifera* genotypes adversely affected the level of pest resistance

V. berlandieri has remained the best donor genotype for adaptation to limestone soils. But were the original *V. berlandieri* genotypes used for breeding the best selections for adaptation to limestone soils? Probably not. This prompted us to explore the natural home of *V. berlandieri* in the southwestern US, to collect there a wide variety of genetic diversity of this species for future breeding.

The high lime soil tolerance of *V. berlandieri* relates to the natural history of its native range. Around 200 million years ago, the land mass of Texas rose and the Gulf of Mexico sank, becoming part of the sea. The ocean that covered the greater part of Texas was slowly drying out and accumulating sediment. In this shallow sea, as the water evaporated, there was a high concentration of calcium and dolomite. In addition, there were many organic sources of calcium, such as the carbonitic and zoogenic sources of calcium, like coral organisms. From this, the organogenic and zoogenic limestone was formed. The Edwards Plateau is found in central Texas. The stones that underlie the area of the Edwards Plateau are limestone that built up during the period 100 million years ago. There is only a shallow layer of soil and the parental rock is close to the surface. The plant community derives from a dry scrub/desert vegetation that lies to the west (*mesquite* community), an oak savanna to the east, and is dominated centrally by a juniper woodland.

MATERIALS AND METHODS

Collection Locations and Details

In September 2005, we collected lots of grapes and berries from *V. berlandieri* in their natural habitat in Texas, with the intention to use the seeds as a source of germplasm. The descriptive list of collection locations, names, and counties is provided in Table 1. The accessions were found in different counties of Texas, west from Austin and northwest from San Antonio, in the geological formation of the Edwards Plateau.

RESULTS AND DISCUSSION

As many as 86 individual wild plants were collected in Texas. The counties in which we collected are Bandera, Bell, Blanco, Burnet, Coryell, Edwards, Gillispie, Hays, Kendall, Kerr, Kimble, Real, and Travis.

The soil of the Edwards Plateau is built from dark, stony clay over limestone. It is on this soil that the *V. berlandieri* is most commonly found. However, this species is also found on the alluvial soils of the riversides. Here on the flat riverbanks are most often found the bigger leafed formed of the species, as water is abundant. On the hillsides, where there is only a shallow soil layer due to the erosion of thousands of years, only the small leafed types are found. This demonstrates the great variability of this species and shows its tolerance not only of limestone soils but also its drought tolerance.

In the area around Fredericksburg, in Gillespie County, west of Austin, are found many small creeks and stands of large trees. There, *V. berlandieri* vines grow thick trunks, growing up to the highest point of the trees and spreading onto the canopy. In contrast is the area of Blanco County, which is fairly dry. Here, the tree growth is not so strong. In this area, the growth of *V. berlandieri* is less vigorous and only reaches heights of 2-3 m. The clusters are mostly smaller and the ripening of the grapes is not uniform, with ripe and green berries found in the same cluster: dark blue berries with brown, ripe seeds, and immature berries with unripe seeds.

Wild species mostly are found only in male or female flowering forms. This reduces the combination possibilities for breeding purposes. The male flowering *V. berlandieri*, when compared to female flowering vines at the same location, is more vigorous and stronger growing. This is probably due to the heavy load of grapes that the female vine must ripen; this provides an additional stress factor to the female vines.

V. berlandieri, V. candicans, and *V. monticola* could be frequently found growing in the same location. However, the great differences in growth habit, leaf shape, hairness, fruit, and other characteristics made it very easy to identify the species. *Vitis candicans* leaves are very woolly, with a dense coat of white hair, so thick on the leaf bottom as to obscure the view of the color, while *V. monticola* has small bright green leaves without hair. The higher the lime content of the soil, the more likely to find *V. berlandieri*. As the lime content increases, the frequency of other species diminishes.

The grape species of Texas live together, side by side in the same habitat, but it is rare to find natural hybridization. The individual vines are male or female flowering, unlike the cultivated species, and so the plants are not self-pollinating. The difference in flowering times is thought to be responsible for maintenance of pure species populations with minimal interspecific hybridization in nature.

CONCLUSIONS

In the 1990s, in Geisenheim, a new program was initiated to breed new rootstock varieties. The aim of the breeding is complete phylloxera resistance in combination with lime soil adaptation and chlorosis resistance. This extensive program began in 1992.

To collect a wider range of genetic variation of *V. berlandieri*, we went to the natural habitat in central Texas. We sampled many individual wild plants and berries and 86 individual wild plants. The counties in which we collected are Bandera, Bell, Blanco, Burnet, Coryell, Edwards, Gillispie, Hays, Kendall, Kerr, Kimble, Real, and Travis. More than 35,000 seedlings extracted from the berries collected in the wild will be planted and evaluated for rooting ability, callusing, lime tolerance, and different growth habits. The best of these will then be used as breeding partners in the new rootstock cross breeding program.